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Retrospective analysis of sociodemographic, laboratory, and imaging characteristics in patients with acute appendicitis

Appendicitis analysis: Demographics and diagnostics

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Abstract

Aim: This study aims to analyze the demographic, clinical, and laboratory characteristics of patients diagnosed with acute appendicitis, as well as the findings from ultrasonography (USG) and computed tomography (CT), to identify critical parameters in the diagnosis and the significance of early detection.

Material and Methods: A retrospective review was conducted on 315 patients diagnosed with acute appendicitis at a tertiary care hospital's emergency department between January 1, 2014, and December 31, 2014. Data on demographic characteristics, clinical presentations, laboratory results, and imaging findings from USG and CT were collected and analyzed. Statistical analyses were performed using SPSS version 15.0, with significance set at $p<0.05$.

Results: Of the 315 patients, 77.8% (n=245) were male, and the majority were within the 18-28 (49.8%, n=157) and 29-39 (21.6%, n=68) age groups, aligning with literature benchmarks. The anatomical location of the appendix was predominantly normal (49.8%, n=157) and retrocecal (40.6%, n=128). Increased white blood cell counts were significantly associated with male gender and acute appendicitis diagnosis, particularly in cases with complications. Imaging findings supported the diagnosis in the majority of cases, with CT being particularly valuable in complex cases.

Discussion: The study underscores the importance of comprehensive clinical evaluation combined with targeted use of USG and CT in diagnosing acute appendicitis, highlighting the role of demographic and clinical factors in risk assessment. Early diagnosis emerges as a critical factor in preventing complications, emphasizing the need for prompt and accurate diagnostic approaches.

Keywords

Acute Appendicitis, Computed Tomography, Ultrasonography

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Introduction

The appendix vermiformis is a tubular structure that is continuous with the cecum and terminates with a blind end. The inflammation of this structure is referred to as appendicitis. Acute appendicitis is one of the most common causes of abdominal pain encountered in emergency medical clinics and is among the pathologies that most frequently require surgical intervention among acute abdominal conditions [1, 2].

The diagnosis of appendicitis is made through the physician's clinical examination, nonspecific laboratory tests, and radiological imaging methods used in suspicious cases. Although patients' histories and physical examinations are generally sufficient for diagnosis, about 20-33% of cases may exhibit atypical symptoms [3, 4].

Delays in diagnosis can lead to serious complications such as abscesses, gangrene, perforation, generalized peritonitis, and phlegmon, which can significantly increase morbidity and mortality rates. Medical or surgical treatment plans based on clinical findings can increase the risks of negative laparotomy and complications associated with appendicitis. Therefore, the use of imaging methods in cases of acute appendicitis has gained importance today. Among the most commonly used imaging methods are ultrasonography (USG) and computed tomography (CT). While USG has high sensitivity and specificity in the diagnosis of appendicitis, it can give false negative results in cases of retrocecal appendicitis. On the other hand, CT is frequently used in differential diagnosis and in reducing the rate of negative appendectomy, offering high accuracy rates in the diagnosis of appendicitis [5, 6].

This study retrospectively examined the sociodemographic, laboratory, and imaging characteristics of cases diagnosed with acute appendicitis at the emergency department.

Material and Methods

This study retrospectively examined the data of patients who presented to the emergency department of a tertiary care hospital between January 1, 2014, and December 31, 2014, and were diagnosed with acute appendicitis histopathologically. The inclusion criterion for the study was patients whose diagnosis of acute appendicitis was confirmed histopathologically. Individuals under 18 years of age, pregnant women, and those who received a diagnosis other than acute appendicitis upon histopathological examination were excluded from the study. The demographic information of the patients, clinical features, laboratory and imaging findings, treatment methods, and outcomes were examined in detail. The analysis of the data was conducted using information obtained from the hospital's electronic health record system.

Statistical Analysis

Statistical analyses were performed using SPSS version 15.0 (Statistical Package for the Social Sciences for Windows) software. The conformity of variables to normal distribution was thoroughly examined using both visual (histograms) and analytical methods (Kolmogorov-Smirnov and Shapiro-Wilk tests). Descriptive analyses for variables that conformed to normal distribution were presented with mean and standard deviation values. The independent samples t-test was preferred for the comparison of two independent groups. The Chi-square test was used for the comparison of categorical variables between groups, and the Kruskal-Wallis analysis, a non-parametric test, was applied for evaluating differences between groups. Analyses for binary group comparisons were conducted using the Mann-Whitney U test. The level of statistical significance was accepted for results with a p-value below 0.05.

Ethical Approval

This study was approved by the Ethics Committee of İzmir Bozyaka Education and Research Hospital (Date: 2015-03-24, No: 11).

Results

In this study, data from 315 patients diagnosed with acute appendicitis were analyzed. When examining the demographic data of the patients by gender and age groups; 77.8% (n=245) were male, and 22.2% (n=70) were female. Of the total 315 patients; 4.8% (n=15) were aged 65 and over, while 95.2% (n=300) were under 65 years of age. Among the 15 patients aged 65 and over; 46.7% (n=7) were male, and 53.3% (n=8) were female. Of the total 300 patients under 65; 79.3% (n=238) were male, and 20.7% (n=62) were female. The distribution according to the second age grouping in the study was: young age rate 54.2% (n=225); middle age 23.8% (n=75), and old age 26.0% (n=15). The study divided appendicitis locations into three groups: appendicitis in its normal position, retrocecal appendicitis, and others, which included diagnoses of subhepatic, pre-ileal, post-ileal, pelvic, and paracecal appendicitis. In patients diagnosed with acute appendicitis, 49.8% (n=157) had appendicitis in its normal position, while 40.6% (n=128) had retrocecal appendicitis (Table 1).

A relationship between gender and the mean value of white blood cell (WBC) count was examined, and a statistically significant increase was found (p=0.045). The mean WBC count in males was found to be significantly higher than that in females (p=0.045). When the relationship between the ages

Table 1. Relationship between the location of the appendix and age groups in patients with acute appendicitis

Frequency Distribution	Total		<65 age		≥65 age	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Normally located	157	49.8	147	49.0	10	66.7
Retrocecal	128	40.6	127	42.3	1	6.7
Other	30	9.5	26	8.7	4	26.7
Total	315	100.0				
	300	100.0	15	100.0		

of the patients included in the study and their WBC values was examined, a statistically significant difference emerged in terms of WBC levels (p<0.001). When WBC values were examined according to the location of appendicitis, the mean WBC count for those diagnosed with appendicitis in its normal position was 13,250/mm³, while for those with retrocecal appendicitis, the mean WBC count was 11,890/mm³. A significant difference was found in terms of mean WBC counts according to the location (p=0.007).

When evaluating the findings supporting the diagnosis of acute appendicitis detected by ultrasonography (USG) in terms of age: of the 300 patients under 65, USG was performed on 292 (97.3%), while direct CT imaging was done for 8 (2.7%) without USG. Of the 292 patients under 65 who had USG, 148 (50.7%) had USG findings supporting the diagnosis of acute appendicitis, whereas 144 (49.3%) had USG findings that did not support the diagnosis of acute appendicitis. There was no significant difference in terms of supportive findings in USG according to the location of appendicitis (p=0.526). Of the total 315 patients diagnosed with acute appendicitis, CT imaging was performed on 116 (35.8%), while 199 (63.2%) were given a surgical decision with USG without CT imaging (Table 2).

When evaluating the complications in patients, perforation occurred in 35 (11.1%), abscess developed in 4 (1.3%), and 276 (87.6%) did not develop any complications. In the 39 (12.4%) patients who developed complications, no significant difference was found in the type of complication (perforation, abscess) developed according to gender (p=0.141). A significant difference was observed between age groups in terms of the occurrence of complications (p<0.001). When analyzing those who developed complications according to the location of appendicitis: of the total 157 patients diagnosed with appendicitis in its normal position; 20 (12.7%) developed perforation, 2 (1.3%) developed an abscess, and 135 (86%) did not develop any complications. Of the total 128 patients diagnosed with retrocecal appendicitis; 8 (6.3%) developed perforation, while 125 (93.8%) did not develop any complications. The occurrence of complications was statistically significant in patients with appendicitis in its normal position compared to those with retrocecal appendicitis (p=0.034). No abscess development was observed in patients with retrocecal appendicitis (Table 3).

Table 2. Distribution of imaging modality and findings by age groups in patients with acute appendicitis

Imaging modality USG USG (+)		Total	≥ 65 age	< 65 age	
n (%)	Supportive findings (+)	156 (51.3%)	8 (66.7%)	148 (50.7%)	
		Supportive findings (-)	148 (48.7%)	4 (33.3%)	144 (49.3%)
		Total	304 (96.5%)	12 (80.0%)	292 (97.3%)
USG (-)					
n (%)	Total	11 (3.5%)	3 (20.0%)	8 (2.7%)	
CT	CT (+)				
n (%)	Supportive findings (+)	90 (77.6%)	11 (91.7%)	79 (76.0%)	
		Supportive findings (-)	26 (22.4%)	1 (8.3%)	25 (24.0%)
		Total	116 (36.8%)	12 (80.0%)	104 (34.7%)
CT (-)					
n (%)	Total	199 (63.2%)	3 (20.0%)	196 (65.3%)	

USG: ultrasonography, CT: Computerized tomography

Discussion

This study encompasses a retrospective review of 315 patients who presented to an emergency medicine clinic and were histopathologically confirmed to have acute appendicitis following surgery. The findings indicate a majority of male patients (77.8%) and a significant proportion of young adults aged between 18-28 years (54.2%), which is consistent with the distribution reported in the literature [7-10]. Regarding the location of the appendix, 49.8% (157) of the cases were found to have the appendix in its normal position, while 40.6% (128) had retrocecal appendicitis, and these ratios are also in line with the prevalent literature [11,12].

The early diagnosis of acute appendicitis is of vital importance for patients, especially in preventing appendix perforation, one of the most common complications of appendicitis. Perforation can significantly increase morbidity and mortality rates in patients with appendicitis. Early diagnosis and prompt intervention can keep the inflammation localized, thereby preventing more serious complications such as peritonitis, abscess formation, and sepsis. Furthermore, early treatment reduces the length of hospital stay, decreases treatment costs, and facilitates faster recovery for patients. Therefore, making a rapid and accurate diagnosis in patients suspected of having acute appendicitis, timely applying optimal treatment methods, and preventing potential complications are of great significance. This process requires the effective use of clinical assessment, laboratory tests, and appropriate imaging techniques, thereby significantly improving patient outcomes through early intervention.

In this study, an increase in the frequency of appendicitis with a normal location was observed with age, a finding for which there are few studies in the literature. The analysis of leukocytosis by gender, where male patients' mean WBC count was found to be statistically significantly higher than that of females, aligns with results found in the literature [13]. It is well-known that white blood cell count is commonly used in

Table 3. Distribution of complications in patients with acute appendicitis according to patient characteristics and appendix location

Complication	Total	Man	Woman	≥65 age	<65 age	Normally located	Retrocecal located
Perforation	35 (11.1%)	30 (12.2%)	5 (7.1%)	5 (33.3%)	30 (10.0%)	20 (12.7%)	8 (6.3%)
Abscess	4 (1.3%)	2 (0.8%)	2 (2.9%)	1 (6.7%)	3 (1.0%)	2 (1.3%)	-
Complication (-)	276 (87.6%)	213 (86.9%)	63 (90.0%)	9 (60.0%)	267 (89.0%)	135 (86.0%)	120 (93.8%)
Total	315	245	70	15	300	157	

the diagnosis of acute appendicitis and is considered a reliable parameter [14].

The differences in WBC values between age groups appear to indicate an increased risk of complications with age. Young age, male gender, and high leukocytosis are recognized in the literature as determinant factors for the risk of acute appendicitis, and our study supports these findings [15]. When examining WBC values according to the location of appendicitis, it was found that the mean WBC count of cases with the appendix in its normal position was higher than that of retrocecal cases, and this difference was statistically significant.

In patients who developed perforation, WBC values were significantly higher compared to those who did not develop perforation; however, there are conflicting findings on this matter in the literature [16]. In the diagnosis of acute and perforated appendicitis, besides white blood cell levels, CRP and bilirubin values are also used as auxiliary biomarkers. It is known, however, that despite these markers having high specificity, their sensitivity is generally low [17].

Ultrasonography (USG) and computed tomography (CT) are used as primary examination methods in the diagnosis of acute appendicitis. In our study, an increase in the diagnostic value of USG and CT, especially in cases with complications, was observed. However, the fact that these imaging methods were not used in every patient represents a limitation of the study. The high rates of negative appendectomies and the high risk of complications mentioned in the literature highlight the importance of timing in surgical decisions and diagnostic approaches.

Limitation

Our study has several significant limitations. First, due to the retrospective design's nature, factors such as missing data or recording errors in the records could affect the interpretation of our findings. Second, our study population possesses limited demographic characteristics, and special patient groups such as pregnant women and children were excluded from the study. This may limit the generalizability of our results. Additionally, since this study was conducted at a single center, caution should be exercised regarding the applicability of the findings to populations in different healthcare institutions or geographical regions.

Conclusion

This study has highlighted the determinative factors in the early diagnosis of the disease by presenting a retrospective analysis of demographic characteristics, clinical signs, laboratory parameters, and findings from USG and CT in patients diagnosed with acute appendicitis. It was particularly found that male gender and young adults are at a higher risk for acute appendicitis; the WBC count and the anatomical position of the appendix are of key importance in the diagnostic process. In cases at risk of complications, a significant increase in the diagnostic accuracy of USG and CT was observed. These findings support the importance of a multidisciplinary approach and early diagnosis strategies in the diagnosis of acute appendicitis, shedding light on critical decision-making points in patient management.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or compareable ethical standards.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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